Environmental Conditions of Three Representative Villages in Central Java(<Special Issue>The Natural Environment and the Socio-Economic Behavior of Farmers in Thailand and Java : A Preliminary Summary Report on "Nature and Man Project" of Kyoto University Center for Southeast Asian Studies)

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III. Environmental Conditions of Three Representative Villages in Central Java

by

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1. Physical Framework of the Island of Java

It is a matter of common practice to subdivide the island of Java into three geographical subregions, namely, West, Central and East Java. The political and administrative subregions follow this conventional demarcation. Although we perceive that the dryness in landscape increases as we go farther eastwards on the island, the climatic difference between West and East Java bears no significance. According to the classification of climate by Thornthwaite's scheme, the whole Java Island, except for the volcanic highlands, falls in Cs or Cd climatic type, where Cs stands for the subhumid climate with moderate winter water surplus, and Cd means the subhumid climate with little or no water surplus.[1] Based on the numerical classification of climate by Kyuma,[2] the major part of lowland of Java is classified as Group I, which is characterized by (1) humid equatorial climate with very small temperature fluctuation, (2) minimum rainfall of ca. 100 mm in August, and (3) maximum rainfall of ca. 250 mm in January.

Physiographically speaking, the most striking feature of Java Island is the presence of a chain of high volcanoes along the axis. The chain of volcanoes, with their peaks 3,000–4,000 m high, not only accentuates the physiography of the island but also strongly controls, the natural setting such as the geological framework, soils, river networks, amount and distribution of rainfall, availability of water resources, stability of water resources available, and controllability of water for agricultural uses. A cross sectional figure of central Java in north-south direction would give us a better understanding of how the volcanoes predominate, and how sharply the high ranges (Fig. 1) demarcate the lowland plateau from the mountainous terrain. In this sense, the island of Java had better be subdivided into another set of physiographic subregions: the volcanic chain of inland Java, the coastal plain, and the Tertiary highland (Fig. 1). By way of summarization, Java Island is categorized into at least four subregions with respect to environmental conditions for agriculture, as described below.[4]

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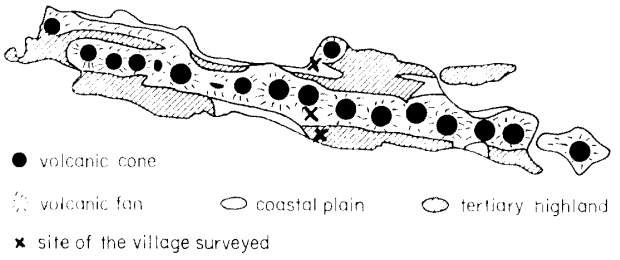

Fig. 1 Schematized geological framework of Java Island

Region A: Volcanic Cone[3)]
Region B: Volcanic Fan[3)]
- a. Upper Volcanic Fan
- b. Lower Volcanic Fan

Region C: Coastal Plain[3)]
- a. Alluvial Lowland
- b. Quaternary Terrace

Region D: Tertiary Highland[3)]
- a. Limestone Plateau
- b. Less-calcareous Hill

Region A is a region of volcanic cone characterized by the steep slopes having rocky surfaces with strips of regosol. Agricultural land use is insignificant except for the lower part of the slopes where spring water can be used for paddy field irrigation at certain advantageous places.

Region B is a region of volcanic fan with steep to gentle slopes covered with fluvially deposited volcanic detritus and volcanic ash. The soil is predominantly regosol whose fertility is medium to low. Water condition is most favorable for the following reasons: firstly, numerous, deep and straight river courses radially dissect the slopes; secondly, river flow is rather stable, often perennial, being fed by abundant rainfall on the volcanic cone throughout the year and also by spring water upstream; and thirdly, every river is deep, with ca. 5-20 m high banks, and the steep slope of the river bed allows easy utilization of the flow by the gravitational irrigation networks. In short, rivers and water on the volcanic fans are controllable even with the communal level of technology. This region is commonly the double rice cropping area reflecting the favorable water availability, and the area is also favored with fair drainability owing to the declining ground surface. Note that the volcano is the determining factor to characterize every agricultural activity in the region.

Region C is a region of coastal plain, where alluvial lowland extends in relatively narrow strips along the northern and southern coasts. Deltaic terrain, if it can be so called, being much smaller in scale than the continental Southeast Asian deltas, is developed north of Krawang, Indramaju, Demak-Kudus, and Surabaya near the comparatively large river mouth. This region is characterized by the flatness with minimal microrelief. But the

landscape is accentuated by the swells of natural river levees on which villages and green woods and brushes are located. Soils of alluvial lowland are clayey and medium in fertility. Rainfall is sufficient for the main rice growing season, though some supplementary irrigation is required to ensure safer transplantation. On the other hand, poor drainability imposes a serious problem upon this flat and monotonous terrain. In the drier period which extends over nearly 4 months, sea water invades the paddy field area, unless a large quantity of fresh water is supplied through canal networks. This is the major obstacle limiting land use during the dry season.

Quaternary terraces, which occupy the relatively wide areas between the alluvial lowlands and the volcanic fans, have an undulating surface covered with latosol. Soil fertility is low. Water conditions are inferior as compared with the adjoining two areas, because of its relatively higher position and undulating topography. Rivers are sparsely distributed, and they are deep. Growing of dryland crops after rice is the common practice in this area.

Most of the irrigation and drainage projects undertaken by the National Government are concentrated in C-type region, aiming at improvement of dry season water supply to promote the double cropping of rice. This region is certainly the area to be most effectively developed with national investment, if the goal is set at self-sufficiency in rice for the nation.

Region D is a region of the Tertiary plateau which is located along the axis of the island. Geologically, the Tertiary highland can be divided into two parts; *i.e.,* limestone plateau and less-calcareous hill.

The limestone plateau is dissected by short and small streams. As is commonly seen in ordinary limestone regions, the river flow is of the flush-flow type and seldom perennial. Surface water seeps rapidly into deeper layers through ubiquitous cracks in the limestone. Rivers are difficult to control. Consequently, the water defficiency and instability of the ground surface totally control the land use in the region. Acreage of paddy fields is not significant except for small patches in alluvial swales. The gougou rice (upland rice) which needs no irrigation water supply, is more common. Maize and sugarcane are the main dry season crops after rice. Cassava, which can grow in the poorest soil and in the most harsh environment, is extensively cultivated as the staple food of farmers in the region.

The less-calcareous hill is dissected deeply by long streams. Thin layers of fluvial deposits are found on the valley bottom. Paddy fields extend in narrow zones along the streams because of the water availability there. Cassava and maize are planted along the marginal zones between the stream and the side slope, and on the higher portion of the side slope are planted mangoes, coconuts, papayas and bananas. Plantations of rubber and occasionally coffee are also seen.

Java, an island of agrarian society, is extremely densely polulated. Cultivated lands occupy most of the island, about 70%. Natural vegetation has been drastically devastated so that natural forests are nearly nonexistent, except in the high ranges. This region, except for the relatively fertile and well-watered stream bottoms in the less-calcareous hills,

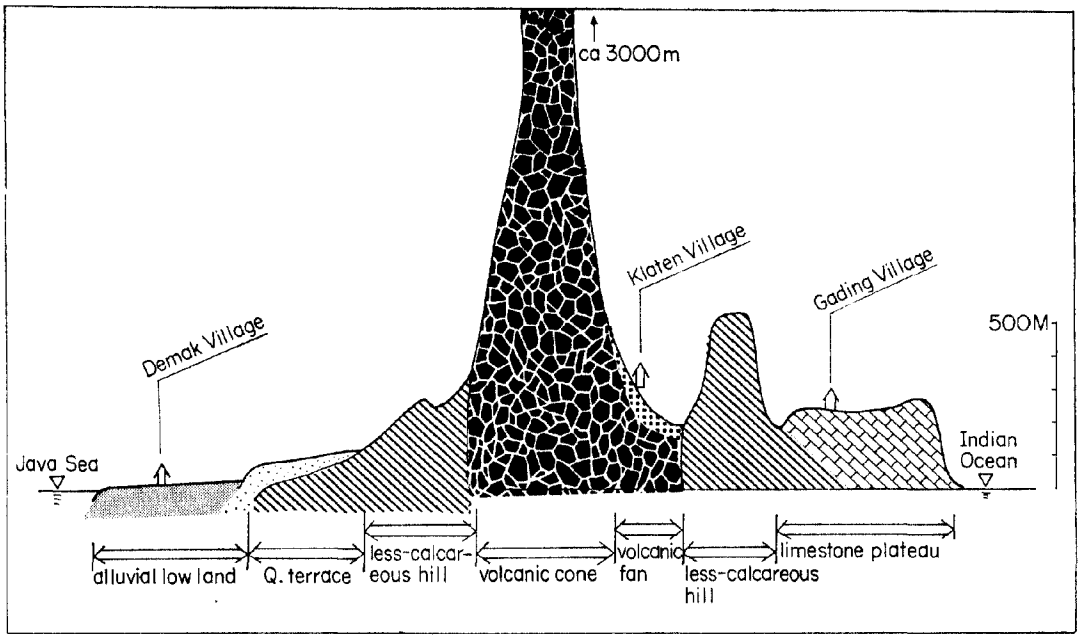

Fig. 2 Schematic N-S cross-section of Central Java

remained undeveloped until not long time ago. Most of the villages in this area, therefore, have a relatively short history of the settlement.

2. Sketches of Three Villages Surveyed

Three villages surveyed are Kahuman, Bonang and Gading, whose locations are shown in Fig. 1 and Fig. 2. Kahuman village is in Region B, Bonang in Region C–a, and Gading in Region D–a. Land and water conditions of each village are briefly described in the following.

(i) Kahuman village (Klaten)

Kahuman village is located ca. 4 km northwest of Klaten, the provincial capital of Kabupatan Klaten. The village stands at an elevation of 200 m on the slope of the volcanic fan formed at the southeast foot of Mt. Merapi. The volcanic fan is composed of relatively thick volcanic materials transported and deposited by surface running water. The ground surface shows gentle undulation. Rivers run along trough-like swales extending from the upper part of the volcano to the foot.

Where the relief is moderate, coconuts and bananas are planted and bamboo grows. Houses are hidden among these trees. The village is rectangle in shape, stretching along a stream (Fig. 3). In this area, a waterway network for irrigation had been constructed during the colonial period, in 1910's, in order primarily to irrigate the sugarcane fields. As the sugarcane plantation has decreased drastically in the area, the irrigation system has been modified to meet the requirements for terraced paddy cultivation. The system, today, has two water sources, one is a spring upstream, and the other is a weir on the Pasur river,

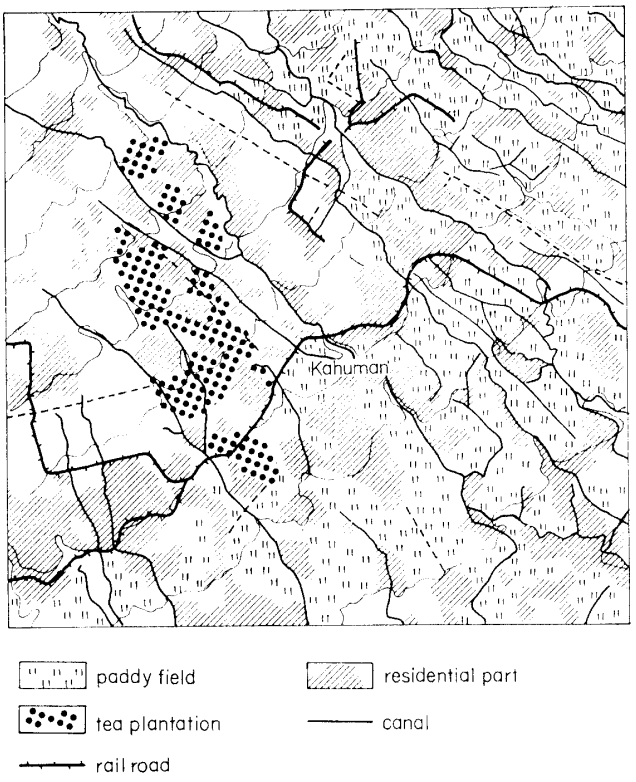

Fig. 3 Map showing Kahuman Village. Irrigation canals are well developed, and houses cluster in the elevated land.

which is again fed by a few springs upstream. These water sources are both perennial. Farmers have devised a very elaborate gravitational water distribution ditch system throughout the village area so that they can harvest double or even triple rice crops a year (on the average, five crops of rice in two years), with the use of the perennial running water (see Fig. 3). Inputs of fertilizers, insecticides and new varieties of rice which ensure larger yield are common. In the ditch system, abundant, crystal-clear running water was seen even in the midst of the dry season when we made the survey. The physical background on which any kind of agricultural innovation can potentially take place seemed to be perfectly consolidated. The controlled water is always the key factor for agricultural innovation.

(ii) Bonang village (Demak)

It is located ca. 8 km northwest of Demak, and in a flat coastal plain facing the Java Sea. This coastal plain is an alluvial lowland covered with alluvial soils. The Tuniang river ca. 10 m wide runs northwesterly through the alluvial lowland from Demak to the sea. The river has an elongated natural levee ca. 2 m high on which the village is located, and the village is surrounded by such trees as coconut, banana and bamboo brush (Fig. 4). In the marginal zone between the levee and the monotonous lowland are planted young trees of the *Sesbania* family (*Sesbania grandis*) on raised beds ca. 3 m wide, several tens of meters long and ca. 1.2 m high. They are a fast-growing firewood and can be "harvested" after

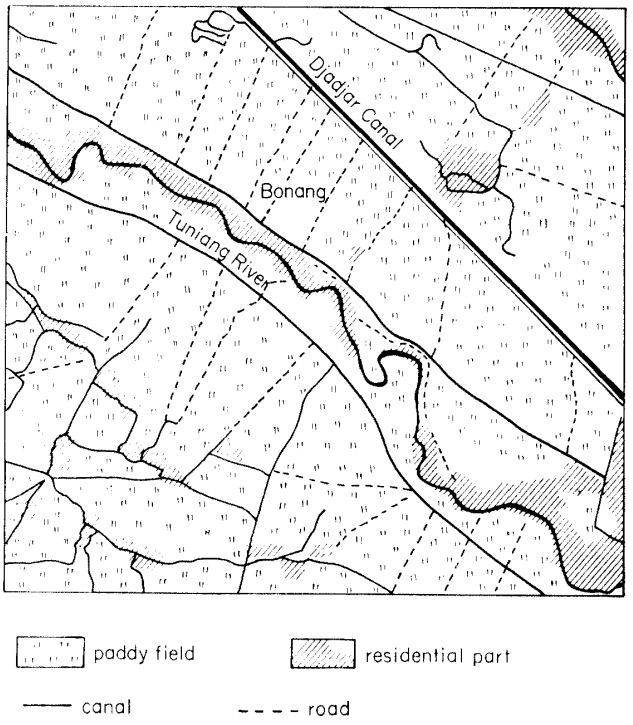

Fig. 4 Map showing Bonang village. Irrigation canals are well developed, and houses cluster on the natural levee.

three years of plantation. The shortage of firewood for daily needs is so serious that the villagers have to "cultivate" these firewood trees in this low flat land. Among the trees are planted cassava on the raised beds, and some rice plants in excavated basins between the beds.

About 2 km northeast of the village, a canalized creek, the Djadjar canal, of ca. 50 m width, runs parallel to the river. The village depends on this canal for supplementing the irrigation water for the main rice growing season, usually January, and for draining water at the harvest time, May. This canal is one of the branches of the main canal which runs along the highway between Demak and Kudus. The canal networks are said to have been constructed early in the colonial period by the Colonial Government. Only one crop of rice can be raised in this lowland because of the sea water invasion in the dry season. The difference of the sea water level between high tide and low tide is ca. 50 cm in ordinary circumstances, but occasionally the sea level rises ca. 2 m, in which case sea water invades as far as 15 km inland and an acreage of ca. 1,600 km^2 in the plain is subject to potential salt injury. To cope with this adversity, the construction of an estuary dam on the Tuniang river is now under way. If, however, the double cropping of rice is the object, the whole canal system in the region will require some modification so as to get a sufficient supply of fresh water in the dry season.

(iii) Gading village

It is located ca. 9 km northwest of Wonosari, the market center of the area. It stands on a rolling terrain of limestone plateau. As the Ojo river, the trunk river dissecting the limestone plateau, is ca. 3 km away from the village, all the streams in the village area are short. Their catchment basins are small and segregated. The river flow is flush-flow type, seldom perennial. Surface running water usually disappears about one week even after an appreciable amount of rainfall in the rainy season, because of the small catchment, poor vegetation and easy seepage of water through cracks in the limestone.

The village area is subdivided into two parts by the microrelief: namely, the part of relative swales covered by black soil and the part of relative swells covered by red soil. The black soil is classified as grumsol, and the red soil belongs to red Mediterranean soils. Both soils are very heavy in texture. The residential section of the village is in the part of swells. Bamboo brushes, coconut, banana, teak and various kinds of fruit trees form tall green covers in the residential section. In the backyard of each house lot are planted several tens of cassava stalks, and some sugarcane and maize plants. Gougou rice will be planted there when the rainy season comes. A visitor will find that even the smallest patch of land is cultivated, so far as the land is usable, for certain foodcrops which are somewhat meagre. Nevertheless, he does feel that the land use here is pretty extensive, rather than intensive. This feeling may come from the fact that the land here is purely rainfed, and in addition, all the crops are dependent entirely upon the inherent fertility of soil.

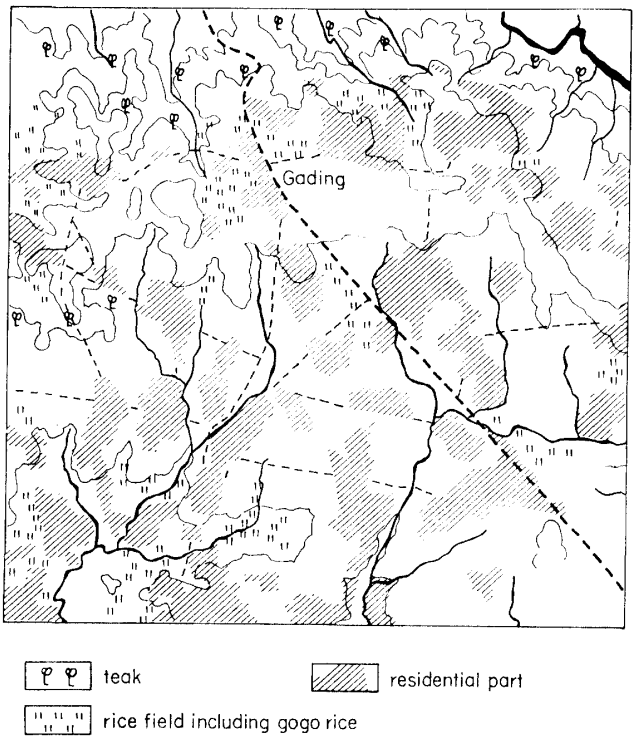

Fig. 5 Map showing Gading village. Paddy fields are localized only in the well-watered part.

As is shown in Fig. 5, paddy fields for wet rice are limited in small patches along streams. On the contrary, the gougou rice acreage has greatly expanded to the area where no irrigation water is obtainable. The black soil on gentle slopes in the swaley portion is usually selected for gougou rice growing, since the swales can preserve much more soil moisture than other parts. Farmers build simple terraces so as to prevent soil erosion, and the land is ready for gougou rice field. They practice shallow tillage twice before planting the rice in November or December. This is their traditional device to preserve as much soil moisture as possible.

The red soil is used for maize and cassava plantation. Maize and soyabean are the major second crops after rice.

Water is the most serious problem in the present relatively extensive land use of the area. A feasibility study of tapping ground water in this limestone region is now under way. Even if the ground water was exploited to some extent, this area has still no possibility to become a paddy rice area because of the poor availability of water. Rather, intensive horticulture and fruit-culture would be more profitable in view of the abundant manpower, relatively fertile soils and of limited water resources.

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